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91st Congress, 2d Session - - - - - House Report No. 91–1801

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# THE SMITHSONIAN INSTITUTION

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## REPORT

BY THE

## COMMITTEE ON HOUSE ADMINISTRATION

PURSUANT TO

Public Law 601, 79th Congress (Legislative Reorganization Act of 1946)

DECEMBER 30, 1970

U.S. GOVERNMENT PRINTING OFFICE

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# LETTER OF SUBMITTAL

U.S. House of Representatives,
Committee on House Administration,
*Washington, D.C., December 30, 1970.*

Hon. John W. McCormack,
*Speaker, U.S. House of Representatives,*
*Washington, D.C.*

Dear Mr. Speaker: By direction of the Committee on House Administration, I submit herewith a report on the Smithsonian Institution. The committee's report is based on a study made by its Subcommittee on Library and Memorials.

With best wishes, I am

Sincerely yours,

Samuel N. Friedel,
*Chairman.*

Enclosure.

# LETTER OF TRANSMITTAL

U.S. House of Representatives,
Committee on House Administration,
*Washington, D.C., December 30, 1970.*

Hon. Samuel N. Friedel,
*Chairman, Committee on House Administration,*
*House of Representatives,*
*Washington, D.C.*

Dear Mr. Chairman: Transmitted herewith is a report of the Subcommittee on Library and Memorials on the Smithsonian Institution.

Wies best wishes, I am,
Sincerely yours,

Frank Thompson, Jr.,
*Chairman, Subcommittee on Library and Memorials.*

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# THE SMITHSONIAN INSTITUTION

December 30, 1970.—Committed to the Committee of the Whole House on the State of the Union and ordered to be printed

Mr. Friedel, from the Committee on House Administration, submitted the following

## REPORT

[To accompany report on the Smithsonian Institution]

### Subcommittee on Library and Memorials Report: Smithsonian Institution, Background and Present Policies, November 1970

#### INTRODUCTION

This report arises out of hearings held into the general background, operations, and policies of the Smithsonian Institution (SI).

Until July 1970, general oversight hearings into the Smithsonian had not been undertaken by a Congressional committee in over 100 years. The last time hearings were held, in 1855, they embraced an institution that was a mere fraction of its present size.

In this context, the Subcommittee on Library & Memorials scheduled public hearings which lasted from July 16 to July 31, 1970. Its inquiry was designed to cover the history of the SI from its creation in 1846 to the present and to gain a thorough understanding of its operations, purposes, and policies—past, present and future.

The purpose of the hearings rests in the fundamental duty of Congress to gather information regarding its areas of legislative responsibility. In addition to the annual appropriations, several bills have been introduced which propose to expand the SI's activities.

Thus, in this Congress, the Subcommittee was called on to study bills that would authorize funds to design what would be the largest radio-radar telecope in the world, to create a standing appropriation



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authorization to permit the SI to build museum and depository facilities whenever needed, to extend the National Museum Act three years at $1 million a year, to assist Living Historical Farms, to establish a National Folk-Life Foundation in Washington, to authorize an Armed Forces Museum, and others.

Also considered by Congress this session were bills filling two vacancies on the SI Board of Regents, expanding the number of citizen regents of the SI by three members, and raising the pay levels of National Zoological Park Police. Reported by the House Administration Committee and now pending in the Rules Committee is a bill to authorize construction of museum support and depository facilities. Final action has been taken by the Congress on bills to extend the life of the National Museum Act, and expand the Board of Regents.

As this abbreviated list of bills affecting the Smithsonian shows, it is entirely appropriate for this Subcommittee to gather information regarding the SI. Although the hearings were not expressly convened for the purpose of airing the criticisms which have recently been made of the SI's operations and policies, the hearings provided an appropriate forum for examining some of the criticism. The hearings also brought out many impressive and constructive achievements of the SI.

## HISTORY OF THE SMITHSONIAN

The man who provided for the establishment of the Smithsonian never set foot in America. A wealthy Englishman with a reputation in science, James Smithson bequeathed $550,000 in gold to the United States and directed that an institution be created ". . . for the increase and diffusion of knowledge among men." He believed the United States, a raw, young nation then, was the only country in the Western world where scientific learning and research could flourish unhindered.

Congress was given the task of carrying out the intent of Smithson's will.

In 1846, after eleven years, Congress established a combination library-museum and scientific research institution and named it the Smithsonian Institution. The original bequest was restored to compensate for some bad investments, and permanently deposited in the U.S. Treasury. Interest of 6 per cent per annum is paid to the Institution for its operating expenses. The first of the SI's many buildings, the Smithsonian Building, was constructed from these funds. It still stands on the edge of the Mall.

The hearing record of July 1970 contains a more detailed description of the history and growth of the Institution. The tables below will provide some idea of Smithsonian expansion since 1846.

## SMITHSONIAN INSTITUTION BUILDINGS

| Building | Completed | Cost |
|---|---|---|
| Smithsonian Institution | 1855 | $319,000 |
| Renovation | (1) | 2,900,000 |
| Arts and Industries | 1881 | 225,000 |
| Natural History | 1911 | 3,500,000 |
| East wing | 1963 | 17,800,000 |
| West wing | 1965 | |
| Freer Gallery | 1921 | 2,000,000 |
| History and technology | 1963 | 36,000,000 |
| Air and space | 1919 | 20,000 |
| Fine arts and portrait galleries | 1840–1967 | 2,700,000 |
| Renovation | 1967 | 7,000,000 |
| Renwick | 1874 | 250,000 |
| Restoration | (1) | 2,400,000 |
| National Gallery of Art | 1940 | 15,000,000 |
| Carnegie Mansion [2] | 1901 | 1,500,000 |
| John F. Kennedy Center for the Performing Arts | 1971 | 66,400,000 |
| National Zoological Park: | | |
| Administrative building | 1805 | (3) |
| Lion house | 1891 | 60,000 |
| Monkey house | 1907 | 50,000 |
| Bird house | 1928 | 225,000 |
| Renovation of bird house | 1964 | 973,000 |
| Reptile house | 1931 | 250,000 |
| Elephant house | 1937 | 285,000 |
| Small mammal house | 1937 | 225,000 |
| Shops | 1937 | 200,000 |
| Restaurant | 1940 | 75,000 |
| Police building and restrooms | 1956 | 197,000 |
| Hardy and delicate hoof stock buildings | 1966 | 1,078,000 |
| Hospital building | 1970 | 936,000 |
| Belmont | 1738 | (3) |
| Silver Hill facility | [1] 1953 | (3) |
| Joseph H. Hirshhorn Museum and Sculpture Garden | 1972 | [4] 15,000,000 |
| | | [5] 1,000,000 |
| Radiation biology laboratory | 1970 | (2) |

[1] Continuing.
[2] Leased to Smithsonian.
[3] Not available.
[4] Appropriated.
[5] Private.

## SMITHSONIAN INSTITUTION OPERATING EXPENSES

| Year | Federal | Private [1] | Grants, gifts, contracts |
|---|---|---|---|
| 1846 | | $4,845 | |
| 1856 | | 38,159 | |
| 1866 | $6,000 | 67,862 | |
| 1876 | 20,000 | 47,128 | |
| 1886 | 168,000 | 41,143 | |
| 1896 | 452,055 | 68,806 | |
| 1906 | 561,029 | 62,632 | |
| 1916 | 589,500 | 105,125 | |
| 1926 | 971,020 | 396,364 | |
| 1936 | 1,177,189 | 448,282 | |
| 1946 | 1,357,561 | 385,336 | |
| 1956 | 4,166,000 | [2] 1,016,345 | |
| 1960 | [3] 7,718,000 | 661,202 | [4] $4,500,272 |
| 1961 | 8,114,000 | 850,838 | 5,247,913 |
| 1962 | 9,125,000 | 684,477 | 6,074,088 |
| 1963 | 11,060,550 | 675,345 | 6,854,937 |
| 1964 | 13,191,000 | 1,632,546 | 9,063,424 |
| 1965 | 15,540,000 | 2,681,397 | 9,401,953 |
| 1966 | 18,921,000 | 4,364,236 | 10,673,035 |
| 1967 | 22,523,000 | 5,166,714 | 13,855,934 |
| 1968 | 24,340,000 | 3,393,423 | 12,146,777 |
| 1969 | 26,443,000 | 4,442,437 | 12,855,852 |
| 1970 | 29,965,000 | (5) | (5) |

[1] Includes expenditures from restricted funds as well as the gross disbursements of the revenuing producing activities. Only about $400,000 has been available for unrestricted operating purposes in recent fiscal years.
[2] Includes $522,000 for research and explorations.
[3] Growth since late 1950's largely a reflection of preparations for and operations of significant additional building spaces for exhibitions, research, collections management, and other public services requiring exhibits personnel and buildings maintenance, operations, and protection personnel (these services not provided by the General Services Administration). New building facilities include the additions to the Natural History Building, the History and Technology Building, the Fine Arts and Portrait Galleries Building, as well as preparations for the Renwick Gallery and the Joseph H. Hirshhorn Museum and Sculpture Garden.
[4] Primarily grants and contracts to the Smithsonian Institution from the National Science Foundation, the National Aeronautics and Space Administration, and other Federal agencies.
[5] Final reports in preparation.

SMITHSONIAN INSTITUTION PERSONNEL

| Year | Federal | Private | Year | Federal | Private |
|---|---|---|---|---|---|
| 1846 to 1916 [1] | | | 1963 | 1,292 | 665 |
| 1926 | 307 | 62 | 1964 | 1,348 | 820 |
| 1936 | 424 | 67 | 1965 | 1,582 | 935 |
| 1945 | 400 | 48 | 1966 | 1,697 | 1,052 |
| 1956 | [3] 543 | 109 | 1967 | 1,792 | 1,009 |
| 1960 | [1] 934 | [2] 402 | 1968 | 1,946 | 1,142 |
| 1961 | 957 | 512 | 1969 | 2,000 | 1,081 |
| 1962 | 1,110 | 420 | 1970 | 2,233 | 939 |

[1] Year-by-year information not available because of fire in 1865 and dispersion of records to archives and records centers. Estimate average of approximately 175 Federal and 25 private.

[2] Growth since late 1950's largely a reflection of preparations for and operations of significant additional building spaces for exhibitions, research collections management, and other public services requiring exhibits personnel and buildings maintenance, operations, and protection personnel (these services not provided by the General Services Administration). New building facilities include the additions to the natural history building, the history and technology building, the fine arts and portrait galleries building, as well as preparations for the Renwick Gallery and the Joseph H. Hirshhorn Museum and Sculpture Garden.

[3] Growth since mid-1950's almost entirely reflects grants and contracts to the Smithsonian Institution primarily from the National Science Foundation, the National Aeronautics and Space Administration, and other Federal agencies.

MAJOR BUREAUS AND DIVISIONS OF THE SMITHSONIAN INSTITUTION EMPLOYEES AND BUDGETS, FISCAL YEAR 1970

| Activity | Positions | Budget |
|---|---|---|
| Office of Director General of Museums | 7 | $233,000 |
| Office of Exhibits | 167 | 2,354,000 |
| Conservation Analytical Laboratory | 11 | 134,000 |
| Office of the Registrar | 29 | 327,000 |
| National Museum of Histroy and Technology | 158 | 2,149,000 |
| National Museum of Natural History | 258 | 3,912,000 |
| National Zoological Park | 220 | [1] 0 |
| National Air and Space Museum | 41 | 486,000 |
| National Armed Forces Museum Advisory Board | 8 | 182,000 |
| Anacostia Neighborhood Museum | 9 | [2] 124,000 |
| Freer Gallery of Art | 7 | [2] 45,000 |
| Joseph H. Hirshhorn Museum and Sculpture Garden | 13 | 308,000 |
| National Collection of Fine Arts | 59 | 1,015,000 |
| National Portrait Gallery | 30 | 768,000 |
| Archives of American Art | 0 | [2] 0 |
| Smithsonian Astrophysical Observatory | 57 | 2,086,000 |
| Smithsonian Tropical Research Institute | 40 | 522,000 |
| Radiation Biology Laboratory | 36 | 676,000 |
| Office of Environmental Sciences | 23 | 565,000 |
| Center for the Study of Man | 6 | 83,000 |
| Center for Short-Lived Phenomena | 0 | [2] 11,000 |
| Smithsonian Research Awards Program | 0 | 400,000 |
| Office of International Activities | 8 | 118,000 |
| International Exchange Service | 9 | 118,000 |
| Office of the Secretary | 38 | [2] 462,000 |
| Academic Programs | 18 | [2] 572,000 |
| Woodrow Wilson International Center for Scholars | 8 | 91,000 |
| Management Support | 43 | 534,000 |
| Officer of the Treasurer | 31 | [2] 573,000 |
| Division of Performing Arts | 7 | [2] 226,000 |
| Office of Personnel and Management Resources | 26 | 388,000 |
| Office of Public Affairs | 12 | 277,000 |
| Supply Division | 21 | 318,000 |
| Information Systems Division | 13 | [2] 217,000 |
| Smithsonian Institution Libraries | 49 | [2] 659,000 |
| Photographic Services Division | 20 | 265,000 |
| Smithsonian Institution Press | 23 | [2] 700,000 |
| Buildings Management Department | 748 | 8,067,000 |
| Total | 2,233 | 29,965,000 |

[1] Appropriations for 200 included in District of Columbia appropriations before fiscal year 1971.

[2] Also receive substantial private fund support.

## National and International Locations of Smithsonian Activities

**1. Washington Metropolitan Area: Headquarters of the Smithsonian and the major center of its museum, zoological park, art gallery, and research and education programs.**

**2. Edgewater, Maryland (near Annapolis): Chesapeake Bay Center for Environmental Studies.**

3. Howard County, Maryland (near Elkton): Belmont Conference Center.
4. New York, New York; Cooper-Hewitt Museum of Decorative Arts and Design, and the administrative offices of the Archives of American Art.
5. Detroit, Michigan; Boston, Massachusetts; Santa Fe, New Mexico: Branch or field offices of the Archives of American Art.
6. Cambridge, Massachusetts, with optical and laser tracking stations in Spain, South Africa, India, Argentina, Peru, Curacao, Florida, New Mexico, Hawaii, Iran, Japan, and Australia: Operations of the Smithsonian Astrophysical Observatory. Also in Cambridge, the headquarters of the Center for Short-Lived Phenomena.
7. Midwestern United States: Camera and radar networks for photography and recovery of meteorites and collecting data on micrometeoroids under the Smithsonian Astrophysical Observatory.
8. Mt. Hopkins, Arizona: Observatory of the SAO.
9. Panama, Canal Zone: Tropical biological studies of the Smithsonian Tropical Research Institute.
10. Burma, Ceylon, Egypt, Guinea, India, Israel, Morocco, Pakistan, Poland, Tunisia, Yugoslavia: Special Foreign Currency Program activities in the excess currency countries (anthropology and archeology, systematic and environmental biology, astrophysics, and museum studies).
11. World-wide: Collecting and other field work by the Smithsonian museums and research centers. Also exchange of publications by the International Exchange Service.

## DISCUSSION

### 1. Bypassing Committee Jurisdiction—The Joseph H. Hirshhorn Museum and Sculpture Garden

The Subcommittee on Library and Memorials is a standing Subcommittee on House Administration. Clause 9(e), House Rule XI, provides the following jurisdiction: "*Except as provided in clause 16 (formerly 15) (d), matters relating to the Smithsonian Institution and the incorporation of similar institutions.*"

Clause 16(d) states:

"16. Committee on Public Works.

* * * * * * *

"(d) Measures relating to the construction or reconstruction, maintenance, and care of the buildings and grounds of the Botanic Gardens, the Library of Congress, and the Smithsonian Institute."

* * * * * * *

In the consideration of the legislation establishing the Joseph H. Hirshhorn Museum and Sculpture Garden, this Subcommittee and the Committee on House Administration played no part. The background of that matter is as follows:

In 1966, following complicated negotiations, President Lyndon B. Johnson accepted, subject to legislative approval by the Congress, a gift of several thousand works of art from Mr. Joseph H. Hirshhorn, an investor who began his career on the Curb Market in New York and later made a fortune in Canada speculating in gold and uranium mining. Mr. Hirshhorn had over the years amassed an extraordinary collection of sculpture and modern American paintings.

By the early 1960's Mr. Hirshhorn's art collection was too large to fit into his various homes here and in Canada. Much of his collection was in warehouses. He began to hint that he would donate the collection if he could find a suitable recipient. The press reported offers from Israel, England, and New York to accept the collection and build a museum to house it. New York is reported to have offered a $10 million museum; England reportedly offered 10 acres and a building in Lon-

don's Regents Park. At about this time, the Smithsonian became interested in the collection and asked the President to intercede on its behalf.

Mr. Hirshhorn agreed to donate the collection to the Smithsonian with certain conditions: that it would be housed in a building on the Mall of the Nation's Capital; that the museum would be named in perpetuity the Joseph H. Hirshhorn Museum and Sculpture Garden; that Congress pass legislation appropriating $15 million to construct a museum building and sculpture garden, and pledge the faith of the United States government to maintain the collection thereafter; that Joseph H. Hirshhorn would nominate four of the ten persons to fill the initial positions on the Board of Trustees; that he and the Secretary of the Smithsonian would jointly select an architect for the museum and a director. In exchange, Mr. Hirshhorn promised to donate several thousand works of art and $1 million in cash, the latter to establish an endowment for the purchase of additional works of art.

These terms and others were set forth in an agreement signed by Mr. Hirshhorn and S. Dillon Ripley, Secretary of the Smithsonian, on May 17, 1966. Up to this point Congress had little if any knowledge of this agreement although the burden of acting to consummate the agreement between Mr. Hirshhorn and the Smithsonian was being placed on Congress.

The Smithsonian drafted legislation which was introduced in Congress and referred by the Speaker to the Committee on Public Works which commenced hearings on June 15, 1966. For a variety of reasons the Subcommittee on Library and Memorials was circumvented and the matter referred to the Committee on Public Works. In its hearings on the bill, the Subcommittee on Public Buildings and Grounds, Committee on Public Works, apparently considered that the Hirshhorn gift was an accomplished fact which it was not in the Committee's province to review.

The Committee on Public Works accordingly did not inquire into the wisdom of accepting Hirshhorn's gift under the conditions he demanded and concerned itself only with the authorization of the building to house the museum. Attached to the authorization were sections creating a board of trustees and their duties and a pledge to provide funds to maintain the museum and collection in perpetuity.

The hearings were rather a one-sided affair with the Smithsonian and the President providing all the "expert" information about the Hirshhorn collection. Most of the testimony concerned the Armed Forces Institute of Pathology, which was housed in an old building on the site desired for the Hirshhorn Museum. Most of the opposition to the legislation was directed at preventing removal of the existing structure of the Institute of Pathology. Apparently, only one person protested acceptance of the Hirshhorn collection. This protest was in the form of a copy of a letter sent to Mrs. Lyndon B. Johnson by Sherman Lee, Director of the Cleveland Museum of Modern Art.

In his letter, Dr. Lee praised the collection, but warned that accepting it under the conditions Hirshhorn had stipulated would be a disadvantage to the United States government and an unnecessary burden on the American taxpayer. He also argued that naming the museum after Hirshhorn would tend to discourage large contributions of art to the museum. Mr. Roger Stevens, the White House cultural advisor, disagreed with Dr. Lee on both points.

The bill was reported favorably and became Public Law 89–788, on November 7, 1966.

During the course of its 1970 hearings, the Subcommittee on Library and Memorials heard testimony which raised questions about the propriety and wisdom of some of the terms involved in the Hirshhorn gift, and about actions taken giving effect to it. Some of these questions include: the location of the museum bearing the donor's name on the Mall; the propriety of appointing an architect to design the museum who at the time was a member of the Fine Arts Commission, which would have to approve the final design: the use of Federal funds to finance upkeep of the collection even though the agreement between Hirshhorn and the Smithsonian stipulates that he would be responsible for "care of" the collection until the building was complete; the removal of $1 million cash he promised to give the museum as an endowment and its placing with Federally appropriated funds to cover the now increased cost of construction.

Many other questions have been raised since 1966. Perhaps one of the most important was whether it was esthetically wise to intrude upon the central portion of the Mall with the sculpture garden portion of the museum, when it seemed clear that the traditional development of the Mall was directed at preserving the integrity of an unbroken sweep of grass linking the Capitol to the Washington Monument.

The Subcommittee on Library and Memorials in its July 1970 hearings heard testimony on both sides of all these questions and concluded that the blame for the hasty manner in which the Joseph H. Hirshhorn Museum and Sculpture Garden was created must be shared by the Congress, the President and the Smithsonian. The people of the United States can be said to have obtained intact an excellent collection of sculpture and modern American art.

Presently, there are two axes extending from the Mall. Each has special significance. The first extends from the Washington Monument to the White House, symbolically linking the first president of the United States to the present one. The second axis extends from the Washington Monument to the Lincoln Memorial, from the monument to the traditional "father" of the Nation to that to its "saviour" during the Civil War.

A third axis, designed recently as part of the Pennsylvania Avenue reconstruction, is not complete. It would extend between 7th and 9th Streets from the Archives building, which houses the Declaration of Independence, to the structure directly across the Mall. At the time it was designed, there was no certainty what the latter structure would be or what it would signify, except that it might be an art gallery and garden. Now, without the careful consideration such a project should receive, the axis is being formed with the Joseph H. Hirshhorn Museum as the structure opposite the Archives building and the Hirshhorn Sculpture Garden as the garden and pools which would form the axis.

The Subcommittee on Library and Memorials notes the absence of any careful public consideration of the significance of this third axis, and of whether a building and garden extending across the Mall should be named after Mr. Joseph H. Hirshhorn.

The Subcommittee recognizes the generosity of Mr. Hirshhorn and the enormous value of his gift, and acknowledges that his gift would greatly enhance the Nation's collection of art.

The Subcommittee also recognizes the efforts of the Smithsonian to build the Nation's collection of artworks by obtaining Mr. Hirshhorn's collection. However, the Subcommittee urges that in the future the Smithsonian consider the total ramifications of all its plans.

Also with respect to the future, the Subcommittee recommends that no Federally financed structure be named for any individual without public examination and disclosure of that person's background and character before final action is taken.

In retrospect the Subcommittee feels that the Congress did not give full consideration to all the implications of the arrangement and the Subcommittee recommends that any such arrangement in the future be given meticulous and deliberate study by the appropriate committees of the Congress.

One issue which has not been resolved is the question of whether the Sculpture Garden should be extended across the Mall as presently proposed. Even though the plan calls for a sunken transverse, the Subcommittee is seriously concerned about the desirability of breaking up the sweep of the Mall with any transverse construction in addition to the present streets and roadways.

In this regard, *the Subcommittee recommends that no further action to carry out the proposed plans for the sculpture garden transversing the Mall be taken until a complete review has been made by appropriate committees of Congress including the Subcommittee on Library and Memorials, the Subcommittee on Public Buildings and Grounds, and the relevant appropriations subcommittees.*

## 2. The Smithsonian: Private Versus Public Nature

The SI is a unique creation of the Congress. Its management is vested in an establishment consisting of the President, Vice President, heads of executive departments and the Chief Justice. Its business is conducted in Washington, D.C., by a Board of Regents of 14 members: the Vice President, Chief Justice of the Supreme Court, three Members of the Senate appointed by the President pro tempore of the Senate; three Members of the House appointed by the Speaker of the House; and 4 citizens of the United States, no two of whom shall be residents of the same state; and two citizen residents of the District of Columbia.

Its day to day administration is handled by the Secretary of the Board of Regents. He serves at the Board's discretion. Since 1846, the Smithsonian has had 8 Secretaries, including the present one.[1]

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[1] See the following:

*Smithsonian Institution Secretaries*

| Name: | *Period of office* |
|---|---|
| Joseph Henry | [a] 1846–1878 |
| Spencer Fullerton Baird | 1878–1887 |
| Samuel Pierpont Langley | 1887–1906 |
| Charles Doolittle Walcott | 1907–1927 |
| Charles Greeley Abbott | 1928–1944 |
| Alexander Wetmore | [b] 1945–1952 |
| Leonard Carmichael | 1953–1964 |
| S. Dillon Ripley | 1964–Present |

[a] Longest term in office.
[b] Shortest term in office.

JOSEPH HENRY—1846–1878

A distinguished physicist and pioneer in discoveries related to electromagnetism, Joseph Henry had a formative influence on the Smithsonian. He firmly established the guiding philosophy of increase of knowledge through original research and diffusion of knowledge

The longest term of office was 34 and the shortest was 7 years. The current Secretary, Dr. S. Dillon Ripley, has headed the Smithsonian since 1964.

The Smithsonian is unique among Federal establishments because of its relative freedom from direct control by any of the Government's major branches and because much of its operating funds are obtained from private sources, such as gifts and income from endowments. For instance, the Freer Gallery of Oriental Art was endowed by Charles Freer in 1915, and depends on its endowment income to increase its

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to men. For Henry, and hence for the Smithsonian, original research often meant new and unconventional pursuits; this tradition of innovation and nonconformity is Henry's greatest legacy to the Smithsonian.

SPENCER FULLERTON BAIRD—1878–1887

From the date of his appointment as Assistant Secretary in 1850, Spencer Baird began to assemble a natural history collection at the Smithsonian, and as Secretary his major accomplishment was the establishment of the National Museum. This great collection of natural history specimens has provided a source for research which increases in value over the years, as well as the means for diffusion of knowledge through exhibits. Baird also undertook important studies in ichthyology, virtually created the United States Fish Commission, and encouraged a program of explorations to increase the nation's repository of natural history collections.

SAMUEL PIERPONT LANGLEY—1887–1906

Astronomer, physicist, and a major figure in aeronautics, Samuel P. Langley's most important act as Secretary was establishment of the Astrophysical Observatory. Also during his administration were established the National Zoological Park, the forerunner of the National Collection of Fine Arts, and the Freer Gallery. During his own time, Langley and the Smithsonian were popularly known for Langley's experiments in aeronautics.

CHARLES DOOLITTLE WALCOTT—1907–1927

Charles D. Walcott, who came to the Smithsonian after a career in the U.S. Geological Survey, remained a dedicated paleontologist throughout his life. He maintained a deep interest in aeronautics, through his participation in the National Advisory Committee on Aeronautics, precursor of the National Aeronautics and Space Administration. Walcott and Assistant Secretary Charles G. Abbot supported the rocket experiments of Robert H. Goddard, an outstanding example of the Smithsonian's support of original research. Walcott, himself a benefactor of the Smithsonian, successfully attracted substantial federal and private support.

CHARLES GREELEY ABBOT—1928–1944

Charles G. Abbot joined the staff of the Astrophysical Observatory in 1895, and over the years of his service as Assistant Secretary and Secretary, his first love was astrophysics and long range weather prediction. His years as Secretary were marked by progress, especially in the Astrophysical Observatory and the National Zoological Park, despite the stresses of depression and war. He also presided over that splendid gift of Andrew Mellon which established the National Gallery of Art, and the gift of art by John Gellately, to the National Collection of Fine Arts.

ALEXANDER WETMORE—1945–1952

A widely known ornithologist, Alexander Wetmore served as Assistant Secretary of the National Museum from 1924 until his appointment as Secretary. During his administration the National Air Museum and the Canal Zone Biological Area—later named the Smithsonian Tropical Research Institute—were added to the Smithsonian. In 1946 the Smithsonian celebrated its one-hundredth anniversary.

LEONARD CARMICHAEL—1953–1964

Leonard Carmichael came to the Smithsonian after a career in physiological psychology and after fourteen years as President of Tufts College. During his term of service some long-needed expansion occurred, marked by construction of the Museum of History and Technology, additions to the Museum of Natural History, and by an expanded and improved staff. The Smithsonian Astrophysical Observatory was restructured and relocated in association with the Harvard College Observatory.

S. DILLON RIPLEY—1964–

The eighth Secretary, S. Dillon Ripley, has a distinguished background in ornithology and museum work. He was the Director of Yale University's Peabody Museum and a member of the Yale faculty, and he is an authority on the birds of the Far East. In six years, remarkable advances have been achieved in Smithsonian activities, including: the Smithsonian Society of Associates, the Chesapeake Bay Center for Environmental Studies, the Renwick Gallery, the Anacostia Neighborhood Museum, the Joseph H. Hirshhorn Museum and Sculpture Garden, the annual Festival of American Folklife, the Cooper-Hewitt Museum, the Woodrow Wilson International Center for Scholars, the Archives of American Art, and the Smithsonian Magazine, as well as the opening of the National Portrait Gallery and the National Collection of Fine Arts in the old Patent Office.

collection and pay many of its expenses.[2] Only maintenance of the building it occupies comes out of Federal funds appropriated to the Smithsonian.

Although most of the physical expansion of the Smithsonian and the bulk of its operating expenses and salaries comes from Federal appropriations, the Smithsonian often regards itself as a private institution. There is evidence that Congress intended for the Institution to exercise the freedom this connotes within the Federal establishment.

Although it wished to insulate the Smithsonian from the disruptive effect of political changeovers in the government, Congress provided adequate means to exercise control over the Smithsonian. It has three Senators and three Members of the House on the Board of Regents. The Executive and the Judicial branches of Government are also represented on the Board of Regents by the Vice President and Chief Justice of the United States. The Congress can control most Smithsonian activities through control of Federal appropriations. The citizen members of the Board of Regents must be appointed by Joint Resolution of the Congress for set terms.

The President's powers over the Smithsonian rest in his power to appoint members to various of the Smithsonian's Commissions and Boards of Trustees and in his power to veto acts of Congress. The Smithsonian depends on many Federal agencies for scientific specimens, historical objects, and other forms of assistance. This assistance is derived through the President.

These devices of public control over the SI, shared by the three major branches of the Federal government, clearly indicate that the Smithsonian is a public institution. Therefore, the Smithsonian's characterization of itself as "private" cannot inhibit appropriate Federal inquiry into Smithsonian activities.

The SI's private nature, such as it is, derives from a point of similarity with actual private institutions of learning and research. The Smithsonian is one of the few Federal institutions that can solicit and accept donations of gifts and bequests of objects, money, real estate, and whatever might serve the purposes of the Institution. If the terms of the donor permit, the Smithsonian may sell or dispose of a gift without going further than its Board of Regents for approval.

### 3. Financial Management

One area in which the terms "private" and "public" are clearly at work is that of financial management. The Smithsonian receives money from four sources:

1. Federal appropriations.
2. Income from endowments and gifts.
3. Grants from Federal agencies and private foundations.
4. Revenue-producing activities.

In Fiscal Year 1970, the Smithsonian's budget (not including construction) was $49,083,000. Of this, $29,965,000 or about 60% was direct Federal appropriations; $2,316,000 was from its Foreign Currency program; $2,802,000 came out of District of Columbia appro-

[2] The Freer Fund, orlginally worth $2 million, is the largest held in trust by the Smithsonian. Its current market value is about $16 million. It is managed by the Smithsonian Board of Regents.

priations for upkeep of the National Zoological Park:[3] $10,600,000 is derived from research grants and contracts (private and Federal);[4] and on the private side, $2,000,000 was from gifts (not endowments) restricted to specific purposes by the donors; $1,400,000 was income from endowments such as the Freer Fund mentioned earlier in this report. Of this latter amount, some $340,000 is unrestricted—that is, the Smithsonian may use the money as it sees fit.

During the hearings, the subcommittee heard testimony that revealed serious weaknesses in the financial management of the Smithsonian.

Over the years, the General Accounting Office (GAO), which regularly audits the Smithsonian's appropriated fund accounts, has recommended to the Smithsonian changes which would strengthen its financial management. Among these were tighter controls over the purchase of goods and services and the expansion of its internal audit staff.

GAO found that numerous orders for goods were placed directly with vendors, and approved by the Smithsonian Supply department *after* the orders were placed. This procedure undercut the opportunity of the proper purchasing authority to "shop around" for lower costs and pre-empted competitive bidding. Federal regulations prohibit this practice, but the real danger is over-committing Federal funds beyond appropriated amounts. Since this problem was brought to the attention of the Secretary of the Smithsonian, he has ordered stricter adherence to Federal regulations and the number of unauthorized purchases has declined.

GAO also found that the Smithsonian did not have a sufficient number of auditors to ensure an adequate internal audit of Smithsonian funds. Before July 1970, the Smithsonian had only one auditor for both private and public funds. Since then it has added four auditors, which GAO feels is a significant improvement.

The GAO also recommended that the Smithsonian reimburse the Natural History Building construction appropriation by the amount of $43,930 from other funds of the Institution on the basis that this amount had been improperly applied to the costs of alterations to the Smithsonian Arts & Industries Building. Smithsonian officials, however, testified that in their opinion this expenditure was a proper one under the contingency allowance in the construction appropriation since the alterations to the A & I Building were necessary to make possible a relocation of the Office of the Registrar from the Natural History Building to allow in turn the proper usage of space in the Natural History Building. The Smithsonian has since received an appropriation of $500,000 to carry forward additional renovation work in the A & I Building; it has been agreed that the Smithsonian would now charge this new appropriation with the amount of $43,930 and credit the same to the construction appropriation for the Natural History Building, thereby bringing this question to a conclusion satisfactory to all parties.

The Smithsonian itself has initiated other steps to improve its financial management, such as changing to Automatic Data Processing to handle its accounts and reorganizing its fiscal department.

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[3] As of FY '71, Zoo expenses will be appropriated directly to Smithsonian.

[4] The largest is from the National Science Foundation and accounted for over 90 percent of the total amount.

It is too early to comment on the full effect of these changes. The reorganization is still under way and the switch to computerization (which has begun) will take one to two years to complete.

The last category of Smithsonian income, that which derives from revenue-producing activities, represents a small portion of total income. It includes revenue from sales of souvenirs in its various museum shops, proceeds of refreshment sales at events such as the annual Folk Festival, income from membership dues in the Smithsonian Associates, income from sale of advertising in the new *Smithsonian* Magazine, and other similar projects. The Smithsonian states that the revenue in such cases is applied to the cost of the project.

GAO was unable to comment extensively on these revenue-producing activities since many of them are partly financed with private funds and the revenue placed in the Smithsonian's unrestricted-fund account. GAO has no legal authority to initiate audits of the Smithsonian's private fund accounts. The Smithsonian conducts an internal audit of its private funds and retains a private CPA firm to prepare a statement. The GAO and the Smithsonian are engaged in the joint study ways in which to improve these procedures. *The Subcommittee indeed wishes to make the following recommendation: that the Smithsonian reveal, in as much detail as is presently the practice with respect to expenditures of public funds, both the sources of private funds and the manner in which they are expended.*

## 4. Employee Relations

Following a March, 1970 announcement that the Subcommittee would hold general hearings on the Smithsonian Institution, the Subcommittee began to receive an increasing amount of correspondence from past and present Smithsonian employees criticizing the Smithsonian's lack of attention to employee problems. When a delegation of Smithsonian employees asked to be heard at the hearings, time was made available to them. Nine present and former employees appeared.

The context in which they presented their case is one of dramatic growth for the Smithsonian. At the end of June 1970, the Smithsonian listed 3,169 on its employment rolls, four times the number it had fifteen years ago. During the same period, Federal appropriations for Smithsonian salaries jumped from $3 to $29 million, and the scope and size of the Smithsonian have grown rapidly. Congress added many new programs, activities, and buildings such as the Museum of History and Technology, the National Portrait Gallery, the National Collection of Fine Arts, the Woodrow Wilson School of International Studies, the Renwick Gallery, and the Joseph H. Hirshhorn Museum and Sculpture Garden. Acquisitions from private sources also add to its growth. Recent ones are the Cooper-Hewitt Museum in New York, the Merriweather Post Mansion in Washington, the Belmont Conference Center in Maryland. Between 1956 to 1970, the Smithsonian's operating budget increased from about $5 million to over $40 million (including private and indirect Federal funds).

Personnel matters are handled by the Office of Personnel Administration, an internal bureau of the Smithsonian. (Name changed in November 1970, from Office of Personnel and Management Resources.) In 1970, the office reported a staff of 27 and an operating budget (in-

cluding salaries) of $388,000. There are 8 counselors to advise employees seeking guidance. The office was without a director for several months. *The Subcommittee considers the long delay in filling the vacancy to be a serious deficiency.*

The employees who testified at the hearings charged the Smithsonian with unjust discrimination, failure to reply satisfactorily to employee requests, harassment of outspoken employees, favoritism in making promotions, and nepotism. Detailed testimony regarding these charges can be found in the hearing record. (*General hearings into the Smithsonian Institution before the Committee on House Administration, Subcommittee on Library and Memorials, July 1970.*) This report will deal mainly with the subject of discrimination.

The question of unjust discrimination was raised by William Wiggins, a member of the Smithsonian guard force. In his words, "There is flagrant discrimination at the Smithsonian, sexually, racially, personally, (and) discrimination within the promotion field. Individuals are promoted, not always on their merits, but because of personal friendships or relationships." Another form of discrimination he alleged was that of promoting 20-year military veterans ahead of Career Civil Service guards. He named employees who had served satisfactorily on the guard force for as many as 20 years and had been consistently denied promotions while others, such as 20-year military retirees, with less time at the Smithsonian, had been promoted.

In replying to this charge, the Smithsonian Office of Personnel Administration denies that any discrimination exists with respect to promotions, yet confirms that members of the guard force who are veterans with over 20 years of military service generally rise in the ranks faster than Career Civil Service guards. It argues that length of service alone does not qualify a guard for promotion and that other factors, such as experience, are taken into account.

The Smithsonian promotion policy is set forth in its Merit Promotion Program. This program outlines the criteria for judging a candidate's fitness for promotion, specifies who will make the judgment, and describes the steps for screening each applicant. It applies to all Smithsonian employees, except those appointed by the Secretary, and is basically the same for all departments, although certain provisions are altered to fit the specialized needs of a given department. In the guard force, candidates are rated on the following factors: "dependability, resourcefulness, cooperation, accuracy, knowledge of guard procedures, contact with the public, courage and mental stability, physical stamina, supervisory potential and maintenance." Then a second-level supervisor "rates" the candidates according to "experience, Smithsonian awards received, and education (credit for high school education only)." The third step is the formation of a "promotion panel", consisting of four persons: one from the Office of Personnel Administration, two representatives from the guard force, and one representative from Local 2463, American Federation of Government Employees. The panel assigns values to the ratings made by the candidate's supervisors. Each candidate receives a score and those with the highest are placed on what is called "the best qualified list." This list, which has no specified number of names on it, is sent to the Office of Personnel Administration where it is further reduced to five names (seven, if more than one promotion opportunity exists). This new list,

called the "certified list", is returned to the Protection Division where the head of the division selects someone from the list to be promoted. This entire procedure is repeated every time a vacancy of GS–5 or above occurs. Some members of the guard force have been through it often, without success. The following case described the experience of one of the guards named by Mr. Wiggins. (From statistics supplied by the Smithsonian Office of Personnel Administration.)

Robert H. Harris, a black man, has served on the guard force for 20 years. He joined in 1950 as a CPC—4,[5] and was promoted to GS–3 in 1958, and to GS–4 in 1965. Between 1964 and 1969 he received five letters of "commendation and appreciation". In 1967, after 17 years on the guard force, Mr. Harris applied for a supervisory position at level GS–6. He qualified and was duly rated by his immediate supervisor. The "promotion panel" scored him as 21st among all the applicants for the position. The panel, however, selected only the top 10 for the "best qualified list": thus Mr. Harris could not be promoted. Mr. Harris decided to try again in 1968. He was rated 9th of those qualified, but this time the "promotion panel" chose only the top 7 for the "best qualified list". Again he could not be promoted. It would appear that Mr. Harris' chance for promotion has been foreclosed by shrinkage of the "best qualified list". He tried again in August 1969 with no success. Other than the fact that Mr. Harris tried three times and failed, no explanation is given as to why he failed.

In March 1969, Mr. Harris and all other GS–4s were automatically considered for promotion to GS–5, one position lower than in the above-mentioned attempts. Thirty-one openings were available and 122 guards were automatically rated according to the Merit Promotion Program. The "promotion panel" placed 66 names on the "best qualified list": Mr. Harris was not among them.

On the basis of available information it is impossible to determine whether Mr. Harris or others in his position have been victims of unjust discrimination. However, the complaints of employees cannot be taken lightly, especially in the absence of proof refuting these complaints. A denial, no matter how sincere, is not enough. Thus far, the Office of Personnel Administration has offered no assurance that discrimination does not exist at the Smithsonian, a fact which raises grave questions about the true understanding that the Office of Personnel Administration has of employee problems at the Smithsonian.

Discrimination is most likely to be practiced where it is least likely to be discovered. The subcommittee strongly feels that the Smithsonian Merit Promotion Program could be an ideal discriminatory device. The promotion procedure described above, with its five steps, seems unnecessarily elaborate and redundant. The fact that no fewer than 8 persons must pass judgment on an applicant for promotion increases the chance that he could be unjustly discriminated against, and that it would be virtually impossible to detect who was responsible for it.

*The Subcommittee suggests that the Smithsonian carefully review its promotion procedures, and should it concur with the opinion of this Subcommittee, not hesitate to establish a new system.*

The question of employee morale arises frequently in correspondence and interviews with Smithsonian employees. The consensus is that

[5] A classification no longer in use.

morale is low in some departments, particularly in the largest, the Buildings Management Department, which has 748 employees (including the guard force of about 270 employees), and in the National Zoological Park, which employs 220. The most common complaint is lack of concern for employee problems and harrassment of outspoken employees. To support these contentions several employees testified before the Subcommittee concerning their experiences.

Mr. Roger Thomas, an employee of the National Zoological Park, told the subcommittee that he had been kept in a job cleaning bird cages for nearly 5 years even though he had medical certificates attesting that he has a serious allergy to birds. Although he had appropriately requested a transfer and the medical officers of the Smithsonian had recognized the validity of his reasons in writing, the Smithsonian personnel office several times expressed no knowledge of his case. It took several years and a letter from a U.S. Senator to get him transferred.

Mr. Francis J. McGrath, a highly qualified and experienced painter from the Building Management Department, testified that he had been refused promotion to a vacant foreman's position after being interviewed for the job by a glazier (a craft having to do with glass), and seeing the job finally go to a carpenter. Mr. McGrath protested. As a result, when he later applied for a vacant assistant foreman's position, he was denied because he reportedly had a bad attitude.

The Subcommittee endorses the decision of the Smithsonian to request the formation of a Commission, composed of members from the Smithsonian and the Civil Service Commission, to investigate all such cases. The Civil Service Commission has made itself available for confidential discussions with any employee who wishes to express a complaint regarding working conditions or personnel procedures. The Commission will report to the Secretary and offer recommendations for improvements.

### 5. Astrophysical Observatory

The Smithsonian Astrophysical Observatory is discussed here partly because it represents one of the many little known, but important, activities the Smithsonian engages in besides its museums, because it reflects the Smithsonian's attempts to provide leadership in certain fields of science, and because major legislation has been introduced that would add significantly to its facilities.

Established in 1890, the Smithsonian Astrophysical Observatory conducts research in astrophysics and related space sciences. It moved from Washington in 1955, to Cambridge, Massachusetts where it now works closely with the Harvard College Observatory. It also maintains scientific facilities elsewhere in the U.S. and abroad. Its sixty scientists are involved in such studies as geodesy and geophysics, studies of the upper atmosphere, celestial mechanics and planetary environments.

A Smithsonian document provides the following description of the observatory's activities:

> One program involves laboratory efforts to simulate planetary environments, particularly that of the early Earth. The work in celestial mechanics has pioneered in the development of high-speed computer programs for the calculation of the orbits of bodies in the solar system. A worldwide network of Baker-Nunn camera stations, which plays a role in a number of Observatory programs, provides data for measuring the Earth's shape, size, and gravitational potential and for determining the density, temperature, and structure of the upper atmosphere. Comets and meteors are also studied through the Baker-Nunn network. Con-

cerning these it provides data for the photometric study of the structure of comet heads, for the confirmation of cometary orbits, and for the analysis of the motion and development of comet tails. In addition, a laboratory project simulates cometary models. The Observatory maintains a network of sixteen automatic cameras in the Midwestern United States for photographing bright meteors, determining their orbits, and facilitating recovery of fallen meteorites. A radar network, also in the Midwest, measures the speed, trajectory, and distribution of micrometeoroids and also the velocity and direction of winds in the upper atmosphere.

The Observatory is an important center for the analysis of meteoritic matter. Several research groups are studying the composition, distribution, and history of meteoritical material in space, in orbit around the Earth, and in the Earth's atmosphere. The Observatory also maintains laboratories for the radioisotopic analysis of meteorites, cosmic dust, and recovered satellite material, as well as facilities for the study of the metallurgy, mineralogy, and petrology of meteorites.

Among these investigations are studies in high-energy physics and the development of gamma-ray detection and measurement instruments for balloon and satellite flights. The Observatory is expanding its ground-based gamma-ray research with the construction of a 34-foot light collector designed to register the Cherenkov radiation generated by the particle shower resulting when primary gamma rays strike the upper atmosphere.

Current flight experiments emphasize satellite instrumentation to observe ultraviolet radiation from stars, galaxies, and other celestial sources. Development of this satellite package, called Project Celescope, is part of the National Aeronautics and Space Administration's Orbiting Astronomical Observatory program. It should yield new information unobtainable from ground-based observatories. Smithsonian scientists have also taken part in the analysis of data from NASA's Orbiting Solar Observatory program.

Theoretical astronomy and astrophysics investigations comprise studies of the history and evolution of the solar system, stellar atmospheres, atmospheric physics, and other subjects. Observatory scientists pioneered in the application of high-speed digital computers to the analysis of the physical processes that create the spectra of stars. By comparing predicted stellar spectra with actual observations, they have already developed important new theories concerning the structure, composition, and evolution of stars.

The radio astronomy program at the Observatory includes, in addition to the radar network, the joint use with Harvard College Observatory of an 84-foot radio telescope for the investigation of atomic and molecular constituents of the interstellar medium.

In the optical astronomy program are such diverse activities as the tracking of artificial satellites, the study of comets, and the observation of flare stars and stellar spectra. The Baker-Nunn camera is one primary observing instrument. The Observatory is constructing on Mt. Hopkins, Arizona, a multi-purpose observatory that will add to the program several conventional telescopes, including a 60-inch one chiefly for stellar observations.

Historical astronomy and astroarcheology are studied by Observatory scientists who have used computers to check astronomical theories of the past and to develop new theories about the possible astronomical uses of megalithic structures and monuments. For example, one scientist has found that the alignment of stones and stone holes at Stonehenge in England with important positions of the sun and the moon indicates the mysterious monument may have been used as a calendar and a computer for predicting celestial events such as eclipses.

The Smithsonian, at the urging of groups of American astrophysicists, has taken the leadership in seeking from Congress authorization to expand its capacity for information gathering in this field. Groups of scientists have been meeting over the last several years to plan just what kind of instrumentation is needed. Their recommendations involve a plan to integrate various existing radio-radar systems and to build some new ones. Their first priority is to build a fully steerable, 440-foot radio-radar telescope which would, in effect, become the National Radio-Radar Observatory.

A radio-radar telescope is a combination of very high powered antennas, receivers and transmitter that enables scientists to "hear"

radio waves from outer space. These radio waves either originate in outer space or are bounced off objects in outer space by the radar-portion of the telescope. The characteristics of these waves can be translated into vital information about outer space. Its advantage over optical telescopes is that it can gather data from sources that are much farther from the earth, things the eye cannot see.

The Smithsonian Astrophysical Observatory presently shares an 84-foot radio telescope with Harvard College Observatory. Other radio telescopes in the U.S. and around the world are at Jodrell Bank, England (250 ft.; planning 400 ft.); Australia (210 ft.); Bonn, W. Germany (328 ft.); Algonquin Park, Canada (210 ft.); Owens Valley, California (130 ft.); Green Bank, West Virginia (140 ft.).

Because radio waves received from outer space help us to determine what lies beyond the frontiers of our own planet, radio-radar telescopes now play an indispensable role in the future of space travel. Data gathered through the use of radio telescopes was significant in the conquest of the moon.

However, the amount of data obtainable by a radio-radar telescope increases with the size of its antenna, or dish. The largest steerable radio-radar telescope in the U.S. at the present time is 140-feet in diameter at Green Bank, West Virginia. The largest in the world is a 328-foot dish now under construction in Bonn, West Germany. Great Britain is planning one 400-feet in diameter. Although some of the knowledge gained at these installations will be available to scientists the world over, the Smithsonian contends that the United States will be left behind unless it begins soon to build a larger, more versatile radio-radar telescope.

The Smithsonian has proposed to Congress what would be the world's largest, fully steerable radio-radar telescope, having a diameter of 440-feet. This does not represent the next step in an international radio-telescope race, but the ability of new engineering techniques to construct what would have been done sooner if it were possible. New light-weight materials for the skin of the dish and advanced support concepts have now made the construction of larger telescopes practical. Previously, the larger dishes were "fixed", that is built into the sides of hills. This restricted their use to the motion of the earth. A steerable telescope is far more efficient and versatile than a fixed one.

A feasibility study, financed by a $1.4 million grant to the Massachusetts Institute of Technology from the National Science Foundation, has determined that a 440-foot radio-radar telescope can be built. Legislation to authorize design money has been introduced in Congress and referred to the Committee on House Administration, Subcommittee on Library & Memorials. The bill, H.R. 13024 (91st Congress), is to authorize the Smithsonian Institution to design and acquire a site for a radio-radar telescope. The amount sought for this purpose is $2 million. The Smithsonian estimates that the total cost of construction would be $19.5 million.[6]

Agency reports were requested from the Navy Department, National Aeronautics and Space Agency, National Science Foundation, Defense Department and Bureau of the Budget. All reports have been favorable, authough the Bureau of the Budget, speaking for the President, in

[6] Additional information regarding the radio-radar telescope appears as Appendix A to this Report.

a letter dated September 2, 1969, stated that H.R. 13024 "would not be consistent with the Administration's objectives". (For above-mentioned reports and comprehensive testimony on this subject—see *Hearings into the General Background of the Smithsonian Institution before Committee on House Administration, Subcommittee on Library and Memorials, July 1970.*)

Following the hearings, the Subcommittee unanimously voted to report H.R. 13024 to the Committee on House Administration with the recommendation that it be reported to Congress for enactment into law.

## CONCLUSION

*The critical nature of much of this report does not, on balance, alter the unanimous view of the Members of the Subcommittee that the achievements of the Smithsonian far outweigh its operational shortcomings. It can be accurately stated that the single most important possible result of this report will be to help solve some of the Smithsonian's existing problems and to avoid similar ones in the future.*

As stated earlier in the report, the blame for some of these problems must be shared by the Congress, and is particularly attributable to the inactivity of this subcommittee in past years. One reason active Congressional oversight has not been exercised in the past is, no doubt, a common misconception of the Smithsonian's role. The popular view is that it is a collection of public museums—the "nation's attic", as it is sometimes called.

Not until this Subcommittee decided to conduct the first general oversight hearings into the Smithsonian since the previous century did the full scope of the Smithsonian's work become known.

Of the subjects covered in the July hearings, only a few were extensively considered by the Subcommittee.

The Smithsonian's value to the people of the United States is impossible to estimate. It can be safely stated that its role is basic and should be continued. Its work and research in science, education, history, the arts, and, of course, in its many museums far overshadow whatever criticisms of the Smithsonian have been made. A brief list of some of its activities will illustrate this point.

## FREER GALLERY OF ART

The Freer Gallery of Art presents one of the world's most distinguished collections of Oriental art. Including works of art from China, Japan, Korea, India, and the Near East, the collection covers paintings, sculptures and other objects in stone, wood, lacquer, jade, pottery, porcelain, bronze, gold, and silver.

## INTERNATIONAL EXCHANGE SERVICE

Through the Smithsonian's International Exchange Service, public and private institutions in the United States transmit their publications to other countries and receive publications from foreign institutions.

### NATIONAL COLLECTION OF FINE ARTS

The National Collection of Fine Arts traces its beginning to the establishment of the Smithsonian, when it was conceived as a repository for all art donated to the Federal government. It became known by law as the National Gallery of Art in 1906.

Strongly emphasizing American art, the National Collection has more than 11,000 paintings, sculptures, and prints.

Under Congressional mandate, the National Collection of Fine Arts is charged with inventorying, studying, and conserving art belonging to other branches of the government (WPA murals, for example); encouraging the development of art on a national scale through exhibits and educational materials designed for schools, art councils, and other organizations at the state and community level; maintaining an art research library; aiding the Art-In-Embassies program which puts American art in the United States embassies abroad; advising on a national crafts program; and lending works of art to government agencies, including the White House, where curatorial assistance is given as well.

### NATIONAL MUSEUM OF HISTORY AND TECHNOLOGY

The National Museum of History and Technology portrays the story of America. The museum's collections comprise a tangible biography of the Republic: from household goods which the colonists brought from their native lands—to the weapons that made them free—to the technology that helped make them wealthy and strong—to the memorabilia of men and women who led them. The depth and scope of these collections are unparalleled.

### NATIONAL MUSEUM OF NATURAL HISTORY AND NATIONAL MUSEUM OF MAN

The National Museum of Natural History and National Museum of Man together comprise one of the world's major centers for the study of natural sciences—in terms both of collections and programs of research on plants, animals, rocks and minerals, fossil organisms, and man himself.

### NATIONAL PORTRAIT GALLERY

The National Portrait Gallery was established in 1962 by an Act of Congress and opened to the public in 1968.

Portraits of men and women who have made significant contributions to the history and culture of the nation are exhibited in the Gallery, which is the only major museum in the Western Hemisphere devoted exclusively to portraiture and one of only four such galleries in the world.

### RADIATION BIOLOGY LABORATORY

The Radiation Biology Laboratory studies the effects of sunlight on living things. Its scientists are interested, above all, in the intricacies of plant life, and how and why plants respond to the different quantities and qualities of radiant energy.

Their research seeks to understand the processes by which sunlight, through the low-energy process called photoregulation, can alter the

structure and behavior of plants. Another vitally important and basic quest is to understand how the sun's radiant energy is converted by green plants into chemical energy in the form of carbohydrates which, with proteins, are the basic food of all creatures on earth.

### SCIENCE INFORMATION EXCHANGE

The Science Information Exchange provides for the national research community a comprehensive, computerized source of pre-publication information about research programs that are planned or actually in progress in the bio-medical, social, behavioral, physical, and engineering sciences.

More than 100,000 notices of research projects are received and processed annually. These records in most cases are prepared by principal investigators and updated each year. Registration of foreign research is limited but growing.

### SMITHSONIAN TROPICAL RESEARCH INSTITUTE

The Smithsonian Tropical Research Institute in Panama is a research organization devoted to the study and support of tropical biology, education, and conservation. Its research focuses broadly on the evolution of patterns of behavior and ecological adaptations. The tropics offer the richest natural laboratory for these purposes. Panama further offers unique zoogeographic characteristics—it is a land bridge to terrestrial life forms of two continents and a water barrier to marine life of two oceans.

The Institute operates Barro Colorado Island, which was set aside for science in 1923 as a 55-square-mile tropical forest research preserve in Gatun Lake, which is the great fresh-water lake formed when the Panama Canal was built.

The latest additions to the Institute's research complex are two marine biology laboratories on the Caribbean and Pacific sides of the isthmus, at Galeta Island and Fort Amador, respectively.

### COOPER-HEWITT MUSEUM OF DECORATIVE ARTS AND DESIGN

This famous New York City decorative arts collection and library, previously known as the Cooper Union Museum for the Arts of Decoration, was faced with discontinuance in the early 1960s because of lack of space and financial problems. It was saved by a major fund-raising drive by supporters of the museum, coupled with transfer from the Cooper Union for the Advancement of Science and Art, a tuition-free educational institution, to the Smithsonian.

Of a scope and quality unequalled in this country, the Cooper-Hewitt collection consists of more than 85,000 decorative arts items. The Museum, opened in 1897, is not only a major assemblage of these materials but also a research laboratory serving professionals and students of design.

### HILLWOOD

Hillwood is a strikingly beautiful 25-acre estate in northwest Washington. There Mrs. Marjorie Merriweather Post has brought together very major collections of Imperial Russian and French art

works. Mrs. Post, in early 1969, deeded Hillwood to the Smithsonian Institution subject to a life estate.

Under the terms of the title transfer, Hillwood will become a public art museum. Mrs. Post's gift also included a montary bequest to provide for all expenses of the museum and gardens.

### OFFICE OF AMERICAN STUDIES

The Office of American Studies was established in 1965 to develop and maintain a bond of common goals and purpose between the various Smithsonian activities related to American studies and the academic community under the Assistant Secretary for History and Art.

### OFFICE OF ACADEMIC PROGRAMS

The Office of Academic Programs helps to place the Smithsonian's vast resources at the disposal of schools and scholars from the pre-kindergarten to post-doctoral levels. The Office conducts a broad range of programs for this purpose.

Visiting research appointments, some of which include stipends, are awarded through competitive selection on the undergraduate, graduate, and post-doctoral levels.

Cooperative agreements with universities make the resources of the Institution available to even more students. With some schools the Smithsonian has set up actual degree-conferring programs, such as a doctorate in American material culture offered jointly by the Institution with the George Washington University. In other instances staff members may spend a semester on the faculty of a university.

Symposia and seminars bring together not only the Smithsonian's own scholars and visiting students, but also distinguished minds from every area of intellectual accomplishment.

Elementary and secondary school teachers find the Smithsonian an invaluable resource for bringing their subjects to life. The office of Academic Programs Division of Elementary and Secondary Education makes it easier for teachers to use this resource effectively. The division provides educational tours of specific halls for thousands of school children each year. In addition there are broadly-structured tours on subjects that might be treated in part in several halls, such as the Industrial Revolution.

### NATIONAL MUSEUM ACT

Under the National Museum Act, passed by Congress in late 1966, the Smithsonian acts as a clearinghouse for advice and assistance to other museums throughout the nation and the world. The Institution, through the Office of the Director General of Museums, fills about 5,000 widely varying requests a year.

### SMITHSONIAN INSTITUTION TRAVELING EXHIBITION SERVICE

Exhibitions for art and science museums, community colleges, and other educational institutions are organized and circulated around the United States and Canada by the Smithsonian Institution Traveling Exhibition Service.

### ANACOSTIA NEIGHBORHOOD MUSEUM

The Anacostia Neighborhood Museum is an innovative experiment in public education in one of the poorer neighborhoods of Washington. This capsule museum in a converted movie theater is operated in close cooperation between the Smithsonian and the local community. Permanent exhibits include a reproduction of an 1890 Anacostia store and a small zoo. Among the museum's most succesful projects has been an exhibit on African culture, featuring art, foods, and fashion. Special exhibits on topics of interest to the community are organized periodically. An exhibition entitled, "This Thing Called Jazz," organized by the museum and featuring live demonstrations, recordings, artifacts, and an environmental room that put the viewer in the middle of a simulated New Orleans jazz parade, was widely acclaimed. A Negro History Week exhibition focused on one of Anacostia's best known residents, Frederick Douglass, a former slave who became a noted journalist, orater, and abolitionist. Included in the exhibit was the world premiere performance of "The Ballad of the Black Dragon," a play on the life of Douglass. By taking its exhibit ideas from an advisory committee of neighborhood residents, the Anacostia Neighborhood Museum has linked its activities directly to the needs of the community and has assured a fresh, nontraditional approach to the role of the museum generally.

### BELMONT CONFERENCE CENTER

An 18th-centry estate at Elkridge, Maryland, thirty-five miles north of Washington, Belmont serves as the Smithsonian's conference center. It was opened in 1967. Meetings there focus on the Institution's fields of special interest—science, history, art, and education.

### DIVISION OF PERFORMING ARTS

By staging such events as the annual Festival of American Folklife, which in 1969 drew more than 600,000 persons to the Mall over a six-day period, this division undertakes to extend and further enliven the Smithsonian's service to the public.

Other Division of Performing Arts activities have included concert programs, modern and folk dance programs, a Christmas Mummers Play, the Japanese Kyogen Theater, and a wide variety of outdoor activities on the Mall, including a summer children's tent theater.

### OFFICE OF INTERNATIONAL ACTIVITIES

This Office has as its primary role initiation and coordination of international programs and activities.

As administrator of the Foreign Currency Program, the Office awards research grants for programs abroad by American researchers and institutions of higher learning. This program provides major support for the Smithsonian's own scientific work overseas. Funds come from the appropriation of the nation's excess currencies abroad arising from the sale of agricultural commodities under Public Law 480. Programs have operated in Burma, Ceylon, Egypt, Guinea, India, Israel, Morocco, Pakistan, Poland, Tunisia, and Yugoslavia. Anthro-

pology, archeology, systematic and environmental biology, astrophysics, ecological studies, radiation biology, history, art, and museology are among the disciplines that have been supported.

### SMITHSONIAN INSTITUTION PRESS

The Smithsonian has achieved its "diffusion of knowledge" aim principally through its voluminous publications, issued by or in collaboration with the Smithsonian Institution Press. In these volumes are represented most of the branches of science—anthropology, ethnology and archeology, botany, zoology, mechanics and aeronautics, physics, chemistry, geology, astronomy and astrophysics, meteorology—as well as art history, the history of science and technology, and the history of American institutions.

In all, many millions of publications have been distributed to institutions and private individuals. The Institution's publications are widely known abroad and have given great impetus to scholarly pursuits.

### CENTER FOR SHORT-LIVED PHENOMENA

Founded in early 1968, the Center for Short-Lived Phenomena provides the international scientific community with a reporting and information service on such phenomena as volcanic eruptions, earthquakes, animal migrations, tidal waves, the fall of meteorites, or apparent biological or ecological changes anywhere in the world.

The Center makes it possible for expeditions to mobilize and travel to areas where momentous but short-lived environmental changes are occurring. Fundamental data can thus be obtained in a timely manner.

### CENTER FOR THE STUDY OF MAN

The Center for the Study of Man coordinates a concerted worldwide program of interdisciplinary studies in the human sciences. Its primary focus is on species-wide problems to which the human sciences can contribute valuable knowledge. Members of the Center include anthropologists and other scholars from around the globe.

### CHESAPEAKE BAY CENTER FOR ENVIRONMENTAL STUDIES

The Chesapeake Bay Center for Environmental Studies, seven miles south of Annapolis, Maryland, is a 700-acre outdoor research laboratory. It is operated jointly with Johns Hopkins University and the University of Maryland. Smithsonian responsibility resides in the Office of Environmental Sciences.

The primary general objective of the Center is to advance existing knowledge of the area's biological populations, communities and ecosystems, and their environmental relationships.

### OFFICE OF ENVIRONMENTAL SCIENCE ECOLOGY PROGRAM

The web of interdependence connecting all living things to each other and their environment is the ecological balance of nature. In the modern world, this can be in many respects a delicate balance.

The primary responsibility of the Ecology Program is to develop meaningful opportunities for ecological studies by Smithsonian and co-operating scientists.

OFFICE OF ENVIRONMENTAL SCIENCES—OCEANOGRAPHY AND LIMNOLOGY PROGRAM

The Oceanography and Limnology Program conducts aquatic research, operates or maintains liaison with vessels used for oceanographic research, supports scientists engaged in collecting biological and geological materials, and provides coordination and technical assistance for marine scientists of other Smithsonian components and other organizations.

The Smithsonian receives a substantial portion of the marine specimens gathered by some 80 U.S. vessels engaged in part- or full-time oceanographic research.

The Smithsonian Oceanographic Sorting Center, located in the Washington Navy Yard with a second unit in Carthage, Tunisia, coordinates collections of marine specimens gathered by governmental and non-governmental scientists and insures that collections are processed for the benefit of science.

These activities by no means cover the entire scope of the work of the Smithsonian. However, they support the Subcommittee's view of the Smithsonian's importance to the Nation. The Subcommittee recommends that Congress revitalize its interest in the Smithsonian and continue to provide the Smithsonian with the means effectively to carry out its mandate "to provide for the increase and diffusion of knowledge among men."

Respectfully submitted:

FRANK THOMPSON, JR., N.J., *Chairman.*
KENNETH J. GRAY, *Illinois*
JOHN BRADEMAS, *Indiana*
JONATHAN B. BINGHAM, *New York*
FRED SCHWENGEL, *Iowa*
JAMES HARVEY, *Michigan*
PHILIP M. CRANE, *Illinois*

## ADDITIONAL VIEWS

Questions have been raised about the value of the Hirshhorn Collection, particularly as it relates to the alleged excessive tax benefits received by Mr. Hirshhorn because of his "gift" to the Smithsonian.

The minority members believe the questions which have been raised about the Hirshhorn project are of a serious nature. They are of sufficient importance to demand a reconsideration of action taken earlier by the Congress.

The minority members recommend that new hearings be held next year which would deal solely with the Hirshhorn project. Mr. Hirshhorn should be invited to testify and given an opportunity to clear his name and reputation of the charges and allegations which have been made.

Upon the conclusion of the hearings and after all competent witnesses have been heard final recommendation should be made as to the final disposition of the entire matter.

FRED SCHWENGEL,
JAMES HARVEY,
PHILIP M. CRANE.

## SUPPLEMENTAL ADDITIONAL VIEWS

The purpose of this document is to report on findings arising out of hearings on the Smithsonian Institution held by the Subcommittee on Library and Memorials of the House Administration Committee. Without intending in any way to detract from the merits of the report, I am compelled to state that I cannot associate myself with the body of the report other than in a very general way.

A primary reason for this is that the hearing transcript has not been printed at this writing so we have not had an opportunity to refer to the hearings prior to participating in any way in the writing or review of this report. Because of conflicts with other committee hearings and meetings, it was possible for me to attend and participate in only some of the hearings. This, together with the fact that the hearing transcript has not been printed and available for reference and study, obviously makes it extremely difficult to assess adequately the information and comment contained in the report as to its completeness, objectivity, and relevance.

Additionally, it was stated in the introductory section of an early draft of this report that the information generated at the hearings has been augmented by Subcommittee staff research concerning the Smithsonian Institution. I certainly have no information at all as to the nature or extent of such staff research or how or to what extent information gathered in that way may have figured in the report.

It is of concern to me that the report contains no mention at all of testimony presented at the hearing concerning the less than adequate status being accorded major components of the Smithsonian, namely the National Air and Space Museum and the Museum of Natural History, by the management of the Smithsonian. This matter was discussed in a lengthy statement Senator Goldwater presented personally at the hearings.

The Senator brought to the attention of the Committee that the National Air and Space Museum has no director and that it has had no director for well over a year even though it has been over 24 months since the last director gave notice of his planned retirement. It is charged that many of the Flight Museum exhibits are badly housed and are deteriorating rapidly. The building labeled the "National Air and Space Museum" is a World War I temporary hanger erected in 1917. The other building used for air and space exhibits is 90 years old.

It was brought to the Committee's attention that though the Air and Space Museum attracts about ⅓ of the visitors to the Smithsonian Park, in spite of its great popularity it receives less than 2% of the Smithsonian's Federal budget and it is understaffed. Until recently the Air and Space Museum was not even considered one of the Institution's science and technology components, but instead was placed into the arts and humanities wing of the Institution. Apparently a very low priority has been assigned to the matter of securing funding

for construction of a permanent building to house the Air and Space Museum, construction of which is already authorized.

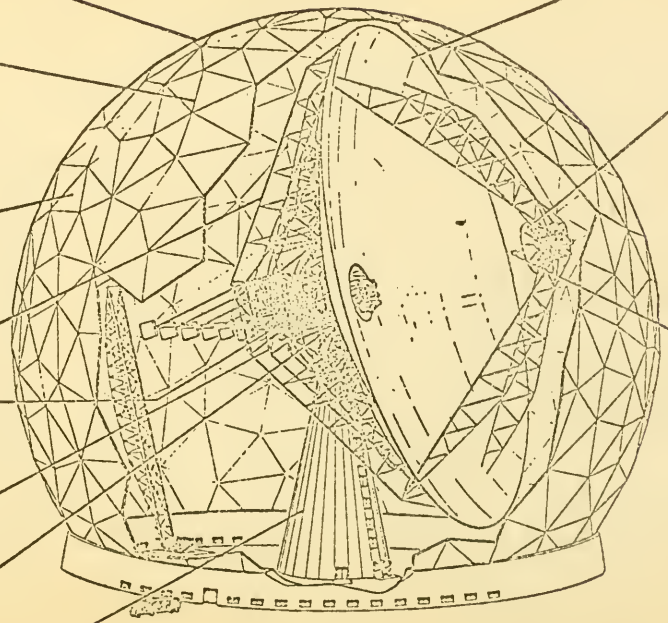
Senator Goldwater states that some corrective steps are being taken, such as refurbishing exhibits. All indications are however that the basic problem, the lack of attention and low priority accorded the National Space and Flight Museum essentially, remains unresolved.

A similar type situation exists with regard to the Museum of Natural History. The lack of support is spelled out in such items as a reduction over recent years in the size of the Museum's scientific and laboratory technician staff, allowing exhibit animals to exist in inadequate condition, and channeling needed resources away from the Museum. Senator Goldwater testified that the Smithsonian Council, a grass-roots body of advisors appointed by Secretary Ripley, informed the Secretary that "the Council is deeply concerned with the present trend relating to systematic biology as it affects the Museum of Natural History and strongly urges the allocation of additional resources to the Museum to promote this field." He indicated that the organization which represents the staff at the Museum of Natural History has issued sharp complaints about the decline in support of the museum.

It is essential in my view that information such as this concerning the lack of attention and support being given the National Air and Space Museum and the Museum of Natural History be brought to the attention of the public in this report.

Since I was not a Member of Congress when the original Hirschhorn agreement was ratified, I will not presume to judge the merits of this decision by those who were then in the Congress. However, our extensive hearings have certainly revealed that any future arrangements of this type should be subject to much greater scrutiny by the Congress and its duly authorized committees before entering into agreements which affect the long-range plans of our Nation's Capital.

PHILIP M. CRANE, M.C.



**RADOME**
HEIGHT 480 ft.
DIAMETER. 560 ft.
DESIGN WIND ~150 mph (at top)

**SPACE FRAME**
BEAM LENGTH ~35 ft.
BEAM CROSS SECTION 3 in. X 15 in.
MATERIAL STEEL
TOTAL WEIGHT 3000 TONS
APERTURE BLOCKAGE 8.6 %

**MEMBRANE**
MATERIAL FIBERGLASS
THICKNESS 0.04 in.
No. OF PANELS ~1400

**REFLECTOR SUPPORTS**
(Vertical truss - 8 total)

**INSTRUMENTATION SPACE**
28,000 cu. ft.
25,000 lbs. wgt.

**COMPENSATION ELEMENTS**
(2 per truss - 16 total)

**HYDROSTATIC BEARING**
~36 ft. dia.

**TOWER**
CONCRETE - 167 ft. high
LAB., OFFICE & EQUIP SPACE ~ 50,000 sq. ft.

**PRIMARY REFLECTOR**
SIZE 440 ft. dia.
CONTOUR PARABOLIC (inverient)
TOLERANCE 0.10 in. (rms)
REFLECTING SURFACE:
ALUMINUM SCREEN, 0.2 psf. wgt.

**SECONDARY REFLECTOR**
SIZE 44 ft.
CONTOUR ELLIPSOIDAL
TOLERANCE 0.03 in (rms)
TOTAL WEIGHT ~6500 lb.

**APERTURE BLOCKAGE**
FEED SUPPORT & SECONDARY REFLECTOR 2.6 %

**AT PRIME FOCUS**
RETRACTABLE FEED
500 lbs. FOR INSTRUMENTATION

**TOTAL MOVING WEIGHT**
ON ELEVATION AXIS 550 tons
ON AZIMUTH AXIS 1050 tons

**DRIVE POWER**
AZIMUTH 15 HP
ELEVATION 25 HP

**POINTING ACCURACY**
10 arc secs.

PROPOSED 440 FOOT VERTICAL TRUSS ANTENNA IN A RADOME

National Science Foundation

*Washington, D.C., October 21, 1969.*

AN INTEGRATED DEVELOPMENT PLAN FOR RADIO ASTRONOMY FACILITIES IN THE UNITED STATES

An aura of excitement without parallel in recent decades pervades the scientific community as a result of astronomical discoveries made in the last few years. The probing studies of astronomers have revealed entirely new classes of objects that are unlike any previously known. Among them are pulsars and quasars, two very distinct types of objects having totally different characteristics, but both having an extraordinary impact on our grasp of physical processes. States of matter and forms of energy generation never witnessed before are now open to study by those scientists who have adequate equipment to pursue the investigation. That these objects were even discovered is a testimony to the astronomers' ability and ingenuity to utilize optical and radio telescopes to their fullest capacity. It is particularly in the newer field of radio astronomy that the most startling discoveries have been made, and it is in this field also that equipment limitations place the most severe restriction on the ability of scientists to probe these new discoveries to the extent necessary to understand them.

Because the National Science Foundation realizes that such an understanding is so important, it has devoted much attention in the last few years to analyzing the need for new radio telescopes. A panel of foremost scientists, the Dicke Panel, was convened both in 1967 and 1969 to consider carefully specific proposals directed toward achieving adequate facilities for U.S. participation in radio astronomical research. In addition, the proposals have been thoroughly studied by the Astronomy Section of the Foundation, and through the Section, reviewed by many members of the astronomical community. The need for basic radio astronomy facilities is now well defined. This paper presents a plan for systematic, phased, total Federal support for the construction of those facilities necessary to continue successfully this nation's efforts in radio astronomy.

There are five separate categories under the general heading of radio telescope facilities to which attention is directed. They are:

(1) The National Radio Astronomy Observatory Very Large Array (VLA),

(2) The large steerable paraboloid proposed by the Northeastern Radio Observatory Corporation (NEROC),

(3) The California Institute of Technology Owens Valley Array (OVA),

(4) Specialized Research Facilities and Equipment (SRFE) in Radio Astronomy, and

(5) A High Precision Antenna (HPA) such as the National Radio Astronomy Observatory Homology Telescope.

The characteristics of the VLA, NEROC, OVA, and HPA have been extensively discussed elsewhere and will not be reiterated here other than those aspects that relate directly to the implementation of an integrated program.

The fundamental objectives in optimizing any telescope design are achieving the best possible resolution (ability to distinguish detail) and accomplishing the observations as economically as possible. Resolution obtainable with telescopes—optical or radio—improves with increasing size and with diminishing wavelengths (higher frequencies). In the optical portion of the electromagnetic spectrum, the wavelengths are relatively small and a modest size telescope with instrumental resolution of a second of arc is an "off the shelf item." Larger instruments are intrinsically capable of higher resolution, but for earth-based telescopes atmospheric variations in the form of small-scale turbulence and scintillation become the limiting factor for optical resolution. Large telescopes are needed because their substantial collecting areas allow them to produce a measurement in a fraction of the time that would be required by one of smaller size.

*VLA*—For radio telescopes, these same basic objectives are sought, but the accomplishment of them is constrained by difficulties not found in optical telescopes. The wavelengths are larger by a factor of the order of ten thousand and achieving a resolution of a second of arc by increasing the size would lead to a telescope approximately 15 miles in diameter (at 10 cm. wavelength)—an obvious impossibility. An alternate method to achieve the same resolution that has been developed by radio astronomers is to take an array of small telescopes that can be accurately pointed and move them about in various patterns within this large diameter circle, taking a reading at each configuration, until a sufficient number of measurements are available to synthesize a total picture. The study of how to accomplish this synthesis with optimization of number, size, distribution and types of antennas, while balancing cost against time to make an observation, has culminated in the VLA proposal. The carefulness with which this study has been made, the extensive testing to establish feasibility, and the far-ranging enthusiasm of radio astronomers throughout the world, witness to the importance of this array for progress in radio astronomy.

NRAO gives the cost of this facility in 1971 dollars as $54.3M. A sub-VLA, viewed as a step towards the total array and not a substitute for it, is valued at $28.6M in 1971 dollars.

*NEROC*—The design-feasibility study for this instrument was supported through a grant to the Massachusetts Institute of Technology by the NSF for approximately $1.5M. The proposal calls for a 440-foot fully-steerable paraboloid to be enclosed in a 560-foot radome. It will be the world's largest fully steerable telescope and represents the results of several years of meticulous engineering studies by groups having an international reputation for excellence. This facility complements the VLA in the sense that its primary objective is to make observations more rapidly than the VLA but at the sacrifice of some of the VLA's resolution. In actual fact, the collecting areas of the VLA and NEROC telescopes are about equal, but the major advantage of the NEROC facility results from having to deal only with one antenna and associated electronics, rather than with 27 as on the VLA. Obviously, the VLA resolution is replaced in the NEROC instrument with versatility. This versatility allows the instrument to accommodate several experiments simultaneously and to change rapidly from one frequency to another, and makes a wide range of frequencies available at relatively modest cost. The large antenna perhaps may be best

categorized as a multipurpose "search" instrument complementing the large array which serves as a "detail" instrument. The two instruments, the large antenna and the large array, cannot be traded off one against the other in facilities needed for radio astronomy. Failure to provide either one becomes a major factor in limiting progress of the science.

The NEROC antenna, in a passive mode, has an estimated cost of $37M in 1971 dollars. The most of adding the radar capability is projected to be $3M.

*OVA.*—The OVA is an array designed to consist of eight 130-foot fully-steerable antennas and associated electronics, and is intended to place special emphasis on spectral line work. The prototype, the first antenna of the array, has been constructed and placed in operation in 1968 for a cost of approximately $2M provided through the NSF.

At first glance, the OVA seems to be a smaller version of the VLA and otherwise simiar to it. In actual fact, the similarity is only superficial in that they are both arrays; they are significantly distinct in their capabilities. The VLA will have more than an order of magnitude higher resolution and will be able to make maps of the detailed structure of radio sources at a rate of several per day. In acquiring its superb resolution and rapid data gathering capability, the VLA becomes less flexible than the OVA in changing operating frequencies and configuration. In the case of the OVA, these can be altered with relative ease to pursue more readily new discoveries encountered with spectral line work. This spectral line work, which is the primary purpose of the OVA, is a significant part of the world wide radio astronomy effort. Many new lines have been discovered and still more, both in compexity and number, will be found if facilities having the OVA capability come into existence. This type of study has inexhaustable potential for gaining knowledge of galactic structure, intersteller dynamics, cosmic abundances, and formation of molecules and grains.

This facility also differs from the VLA in that it would be operated by a single university, California Institute of Technology. The competence of their scientific staff is beyond question, and they have been responsible for much innovative, leading research work in radio astronomy. Further, this competence is supported with additional outstanding facilities and staff in optical astronomy, and in theoretical and laboratory astrophysics. The first antenna in the array is operational and there are no important technical questions that have not been considered. This instrument will also be available to scientists from other institutions, and thereby assure its maximum utilization. A sub-OVA (four antenna array) is of moderate cost and can be put into operation rapidly.

The cost of the complete OVA is estimated at $21M, in 1971 dollars, and the completion of the sub-OVA at $7M. The sub-OVA should preferably be funded in a single year to achieve maximum advantage of cost reductions available from producing the three antennas and associated electronics in a single order.

*SRFE.*—Specialized Research Facilities and Equipment for radio astronomy is an area of pressing need in the nation's universities. There are presently some 40 universities in the United States offering graduate training in astronomy. They have their own optical facilities, for the most part modest in size but essential to the training of astronomers. In many instances, graduate students and faculty alike use the

national centers, with their more powerful instruments, to accomplish major research programs that cannot be pursued with smaller instruments. Nonetheless, these modest instruments in university observatories are an integral part of the nation's effort in optical astronomy. Much of the significant research work is done with them. That work helps to define the problems that require use of large instruments of limited availability and consequently helps to assure that the few large optical telescopes will be used to maximum advantage. They obviously serve a useful function in the education of astronomers, not only because of the original work performed with them, but also because of the expertise that is acquired in the use of a telescope. This enables the investigator to advance more efficiently to large optical instruments.

Radio astronomy, however, developed along different lines. It originated in a few large centers, often independent of academic concern, and was supported by mission-oriented agencies of the Federal Government. Today, some 20 years after its being recognized as a powerful adjunct to the general field of astronomy, radio astronomy still has only a few facilities located at universities. This science has matured so rapidly that it is now evident that radio astronomy is an equal partner with optical astronomy. In reality the two are not distinct in subject matter, but rather differ insofar as they use instruments developed to work in their specific portions of the electromagnetic spectrum. Consequently, efficient utilization of the nation's scientific capability and talent in radio astronomy requires that a strong base be established at universities throughout the country—as is the usual case in all fields of science. More radio telescopes of modest size in the nation's university astronomy departments would assure that much of the basic work would be done in the universities and, accordingly, that maximum effective use would be made of the national centers. It is in the universities that most of the new insights of understanding are conceived and tested, that new areas of investigation are proven feasible, and that state-of-the-art techniques and equipment are developed. In supplementing the resources of the universities to better use the abilities and ingenuity of the graduate students and faculty, the dynamic aspects of this exciting field would be preserved and strengthened, and a basis for continued financial support by the universities would be established. The Foundation supports the recommendations of the Dicke Panel and, indeed, of all the astronomical community, that the base of radio astronomy in universities must be strengthened.

The estimated cost of such a program is $50M. The large facilities discussed earlier are urgently needed in support of the nation's immediate scientific concern. It is, however, equally imperative that the foundation for radio astronomy be strengthened at the university level.

*HPA.*—The currently planned large radio telescopes have an effective short wavelength cut-off at a centimeter or two. To be effective at a wavelength of 1 cm., an antenna should have a tolerance of a root-mean-square surface variation of $\pm 0.025$ inch (1/16 of a wavelength). Structural deflections are an inherent factor in the movement of steerable antennas, in turn producing surface deformations, and the larger the antenna the more difficult it becomes to hold the surface deformation within acceptable bounds for short wavelength (high

frequency) observations. A 1 mm. instrument requires a surface accurate to ±0.0025 inch which with increasing size becomes more difficult to achieve. Accordingly, those telescopes working at wavelengths as short as a millimeter have been restricted to relatively small size, for current technology has not permitted them to be made sufficiently rigid to maintain the necessary surface tolerance.

The largest existing U.S. telescope of this capability is a 36-foot diameter instrument. Such small instruments, however, lack collecting power and as a result have very low sensitivity. At the same time, cursory explorations with these small instruments indicate that more extensive knowledge of this high frequency portion of the electromagnetic spectrum is essential to our understanding of the nature of a vast number of radio sources. As of this writing, there is not a clear solution to the problem. The homology design of the National Radio Astronomy Observatory does predict that large (several hundred feet in diameter) antennas can be built in such a manner that a parabolic surface may be maintained to the required accuracy to work effectively in the 8 mm. region—a significant advance. There are now adequate engineering and design studies of this type of telescope to expect its capability to meet the standards of a high precision antenna within a few years' time. It appears that the nation should build one such large instrument as soon as its feasibility becomes technologically certain, for there is increasing concern with our lack of accessibility to this high frequency region.

Studies made by the NRAO indicate that a 200-foot antenna of this capability would cost of the order of $25M.

*Suggested Schedule of Support*

Two schedules for total Federal support are presented in this section, each in terms of 1971 dollars. The seven-year schedule is preferred, for it allows each of the facilities to be constructed and placed in operation over an optimum period of time compatible with the least cost.

7-YEAR SCHEDULE
[In millions of dollars]

| | VLA | NEROC | OVA | HPA | SRFE | Total |
|---|---|---|---|---|---|---|
| Fiscal year: | | | | | | |
| 1971 | 2 | 2 | [1]7 | | 5 | 16 |
| 1972 | 12 | 13 | | | 5 | 30 |
| 1973 | [2]15 | 13 | | | 8 | 36 |
| 1974 | 10 | [3]9 | 7 | 2 | 8 | 36 |
| 1975 | 10 | 3 | | 8 | 8 | 29 |
| 1976 | 5 | | | 10 | 8 | 23 |
| 1977 | | | 7 | 5 | 8 | 20 |
| Total | 54 | 40 | 21 | 25 | 50 | 190 |

[1] Sub-OVA.
[2] Sub-VLA completed.
[3] Radio telescope completed but not including radar.

10-YEAR SCHEDULE
[In millions of dollars]

| | VLA | NEROC | OVA | HPA | SRFE | Total |
|---|---|---|---|---|---|---|
| Fiscal year: | | | | | | |
| 1971 | 2 | 2 | [1]7 | | 2 | 13 |
| 1972 | 8 | 8 | | | 4 | 20 |
| 1973 | 8 | 8 | | | 4 | 20 |
| 1974 | 9 | 10 | | | 6 | 25 |
| 1975 | [2]4 | [3]9 | | | 7 | 20 |
| 1976 | 2 | 3 | 7 | 2 | 6 | 20 |
| 1977 | 10 | | | 6 | 4 | 20 |
| 1978 | 9 | | | 6 | 5 | 20 |
| 1979 | 2 | | | 6 | 8 | 16 |
| 1980 | | | 7 | 5 | 4 | 16 |
| Total | 54 | 40 | 21 | 25 | 50 | 190 |

[1] Sub-OVA.
[2] Sub-VLA completed.
[3] Radio telescope completed but not including radar.

*Additional Remarks*

This report does not direct itself to the justification of the need of these facilities. The scientific community and many committees and panels both from within and from outside of the Federal Government have recommended their being brought to fruition as rapidly as possible in the nation's scientific interest. This report does reflect the view that it is necessary to present a systematic schedule of funding to accomplish these goals. The amount requested, though a very small fraction of the nation's budget, is large, and every effort has been made to program the implementation in the most economical manner. To this end, it should also be noted that in the interest of both economy and scientific capability, the VLA and NEROC telescopes could be located at the same site in the southwestern United States.

One additional point is that none of the facilities considered here is an instrument planned for the short-term solution of a single particular scientific problem. They are all long-life facilities whose usefulness is not contingent on the variations of the major thrust of science at a particular moment in time. These instruments will continue to provide new insights and understanding of the fundamentals of man's physical world for years to come.

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